

GASTRO-INTESTINAL STUDIES, NO. X: AN ANALYSIS OF ACHYLIA GASTRICA.

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ACHYLIA gastrica stands at the bottom of the long list of secretory disturbances as the expression of the total lack of both enzymes and secretion. Various authors have tried to picture a characteristic clinical syndrome, but the fact remains that the recognition of achylia gastrica can only be made through a direct examination of the intragastric mechanism. This means that an examination of the gastric contents is absolutely essential, although some observers claim that its presence can be recognized by fecal examination. In a summary of the many contributions to this subject, it is evident that the time-worn method of the administration of the test meal and its removal in one hour have been employed. This means that the commonest of all misdiagnosed conditions in this field can scarcely be separated. I refer to the spurious achylia which I shall discuss in the latter part of this article. The introduction of the functional method opens up a new line of study in this field. It enables us to follow the transit of food through the entire cycle of gastric digestion into the duodenum, and there we find a more or less characteristic observation in true achylia, namely, the passage of food into the intestine which is similar in every way to that merely macerated by saliva, for instance, and not chymified. In a true achylia, and speaking broadly I mean a complete achylia, there is no evidence of gastric secretion in any phase of gastric digestion. Not only is there no free hydrochloric acid and practically no total acidity, but pepsin and rennin are lacking. This is rarely the case in gastric neoplasm. Today from the classical studies of Pawlow as well as many other observers we divide the gastric secretion into psychical and chemical phases. The psychical secretion we have been able to demonstrate with normal individuals. If this be true, therefore, that there is a definite psychical secretion initiated through the pathway of the vagus, whose tonus is probably maintained by certain internal secretions (probably parathyroids (?) and possibly thyroids (?)), and a definite chemical secretion incident to the formation and absorption of substances elaborated in the course of digestion, so-called secretagogues and hormones, it should follow that suppression of either of these phases should lead to a psychical or chemical achylia. The investigation of the entire gastric phase would then give us information as to the possible failure of one

or the other of these secretions. A total absence of secretion during the first hour of digestion followed by a perceptible secretion in the second would favor this view-point, namely, that a psychical achylia (nervous) exists, the reverse a pronounced secretion during the psychical phase would favor the interpretation of a chemical achylia. A total lack of secretion through both phases might indicate a deficiency of both functions, or an inactive mucosa, or possibly the failure of material in the blood from which the gastric secretion is derived.

Our studies have indicated that in the majority of cases a complete achylia occupying both phases occurred. We have, however, found several cases in which there was a manifest achylia for one hour or more followed by a perceptible secretion in the second phase, namely, a true nervous or psychical achylia. The reverse, a chemical achylia we have never encountered.

Until we know fully the mechanism and actual formation of the gastric juice, the definite causes producing these secretory phenomena must escape us. It is of interest to note, for instance, that after parathyroidectomy, Carlson and Keating¹ were able to demonstrate a marked deficiency in gastric secretion which was aided and improved by calcium salt administration. On the basis of this observation, in two cases of pronounced persistent achylia of long duration, one of them over ten years, we were able to demonstrate a perceptible and distinct return of secretion during the first hour of digestion. Dr. Bergeim, in our laboratories, elaborated an interesting hypothesis on the origin of gastric hydrochloric acid.²

According to this hypothesis the hydrochloric acid is formed from the NaCl of the blood through the interaction of this substance with an acid phosphate in the gastric cells. It was suggested that the acid phosphate was more probably the Ca acid phosphate than acid Na phosphate, because *in vitro* it is much easier to decompose NaCl by the action of the Ca salts. This is due to the fact that the acid Ca phosphate readily hydrolyzes with the formation of a basic Ca phosphate and free phosphoric acid, while the Na salt does not do this. According to him the formation of such an acid salt in the gastric cells presents no great theoretical difficulty, as organic P compounds, particularly nucleic acids, are found in all tissues, and are associated with enzymes capable of splitting off the phosphoric acid. Further, the nucleic acids appear often to exist in combination with Ca. According to this view, the organic P compound may be furnished by the blood. The findings of high acidity and efficient digestion associated with hyperfunction of pituitary and thyroid and the opposite in hypofunction, as well as decrease in secretion after parathyroidectomy, are interpreted to

¹ Keeton, Amer. Jour. Physiol., 1914, xxxiii, 25.

² Proc. Soc. Exp. Biol. and Med., 1914, xii, pp. 21-22.

indicate an influence of these glands over the mobilization and decomposition of the organic P compound.

This question is worthy of extended study and investigation, and is mentioned owing to its interest and importance in connection with the cases which we report here.

DISCUSSION OF CASES.—The results in these cases are recorded in terms of $\frac{N}{10}$ NaOH, the pepsin was tested by the mettl method, and in cases where rennin is marked absent, undiluted content failed to act on milk.

CASE I.—Mr. E., patient, was a perfectly healthy young farmer up until a short time before admission into the hospital, when he developed trouble with the ankle-joint and knee-joint on the left side; the patient otherwise was in perfect health, and said that his stomach in no way bothered him. The tube was passed and retained, and specimens removed at fifteen-minute intervals. In one and a half hours after the administration of an Ewald meal the stomach was found to be empty and the rapid motility characteristic of that condition was found to be present. Patient's nutrition was satisfactory and the intestines were able to maintain, to a remarkable degree, their vicarious function.

Time.	Total acidity.	Free acidity.
15 minutes	1.0	0
30 "	1.5	0
45 "	2.5	0 no enzymes
60 "	2.5	0
90 "	3.0	0

These figures are practically equivalent to a total absence of all secretion, and the enzymes were lacking. A study of the specimens collectively and separately showed no mucus, no blood, no evidence of any pathological cytology, in fact, nothing but a wet achylia with absolutely no evidence of inflammation. In this case the whole phase shows achylia, and in the absence of any evidence of inflammation, fermentation, bacterial action, and any local or constitutional disturbance incident to the gastric condition, I can only consider the condition a glandular one. Unfortunately, further studies were impossible. Vicarious intestinal function was almost complete.

CASE II.—Mrs. B., aged fifty years, four months loss of appetite; loss of weight; pain in the epigastrium, and in fact everything which suggested gastric carcinoma; no palpable mass; no vomiting. This case, which is of great interest, was in the service of Dr. Solis Cohen, in the Jefferson Hospital, and it was with his kind permission and coöperation that I was enabled to study the case. Owing to the lack of appetite and the epigastric pain, the patient had refrained from eating and lost considerable weight.

Examination revealed a soft, rather relaxed abdomen, in which the stomach could be distinctly outlined by inflation extending

to the level of the umbilicus, absolutely free from any palpable masses, and in which no tender points could be palpated; nor was there any splash or clapottage. The passage of the fractional tube on the empty stomach failed to reveal any appreciable residuum, and there was no retention or food rests, and no hypersecretion. An Ewald meal was then given, and after the first few samples, which were rather liquid, material having all the characteristics of a dry achylia was removed. The material was removed at intervals until the one and three quarter-hour interval, when the

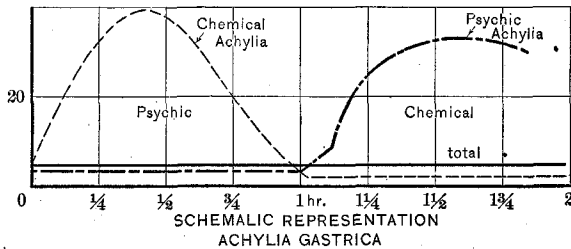


FIG. 1

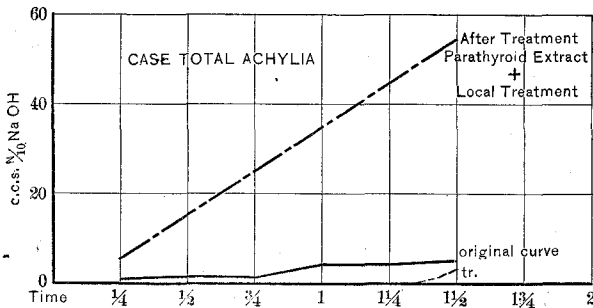


FIG. 2

stomach was found to be empty—a lavage confirmed this finding. The results of this first examination are as follows:

Time.	Total acidity.	Free acid.
20 mins.	1.0	0
30 "	3.0	0
40 "	2.5	0
1 hour	1.0	0
1 1/2 hours	4.0	0
1 3/4 "	4.0	0
1 1/2 "	low	0

This was repeated three days later with the same findings. An examination of different portions revealed neither pepsin

nor rennin, nor was there mucus, occult blood, or bacteria in any of the specimens. The albumin reaction did not exceed $\frac{1}{80}$ in any phase, and there were no cytological findings, no lactic acid was found, and absolutely no signs of putrefaction. I was compelled, on the strength of this examination, to make a diagnosis of benign achylia, and shortly after Roentgen-ray examination revealed absolutely nothing in the stomach. Examination at that time revealed a small palpable mass in the inner aspect of the cecum corresponding to the appendix, and toward this were peristaltic waves, small intestinal, indicating a probable obstruction in this region. An achylia diet was instituted; the patient was given parathyroid extract, and shortly afterward commenced to gain weight. In a comparatively short time her appetite had returned.

A second test several weeks after the first observation revealed the following curve:

Time.	Total acidity.	Free acid.
5 mins.	7.0	0
15 "	15.5	Trace
30 "	11.0	Trace
45 "	3.0	0
1 hour	8.0	0
1½ hours	0

Shortly afterward she continued to improve, and in the interval gained seven pounds, was free from pain, and eating liberally. Her subsequent history was not so satisfactory; shortly afterward she suffered from grippe and was readmitted into the hospital in very bad shape; marked headache; severe pain in the back; lassitude; and a mass in the right side; 23,000 leukocytes; probable carcinoma of cecum, with infection and abscess formation. Her condition was so poor as to prohibit intervention, and she died, without permission from the family for an autopsy. Of one thing I am certain, that in this case the gastric symptoms were not due to carcinoma ventriculi. The mass in the right side was small and insignificant, and was probably an early carcinoma of the cecum. In this case all the improvement, as shown in two examinations, was on the psychical side of the curve—no improvement was noticeable later in the curve—and the case is of interest as registering a distinct improvement under parathyroid.

CASE III.—The following case was a very intelligent gentleman, M. P., referred to me by Dr. Nylin. To all intents and purposes he was perfectly healthy, and there were no gastric symptoms whatsoever. He complained only of looseness of the bowels, from which he had suffered for many years; it was scarcely looseness, rather than an undue frequency of the bowels. Careful examination showed high blood-pressure 160, accentuated aortic, very early signs of interstitial changes in the kidneys, some gouty tendency. Examination of the movement showed a malassimilation of car-

bohydrates and connective tissue in small amounts. His curve was as follows:

Time.	Total acidity.	Free acid.	Pepsin.	Rennin.
15 mins.	3.1	0	0	0
30 "	3.1	0	0	0
45 "	3.0	0	0	0
1 hour	6.0	0	0	+
1 1/4 hours	4.0	0	+ trace	++
1 1/2 "	23.0	Trace	0.5 ²	++
1 3/4 "	31.0	Trace		

This case is extremely instructive. It shows according to the ordinary technique, an achylia, but by the fractional method it shows a total psychic achylia, distinct evidence of a chemical

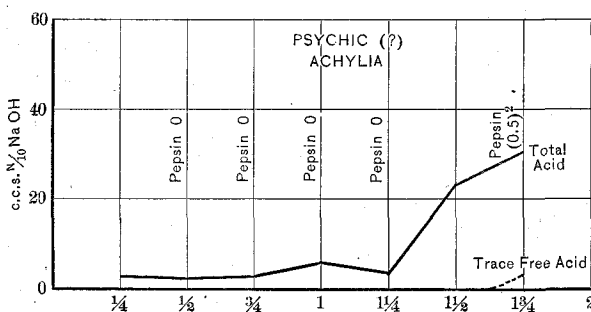


FIG. 3

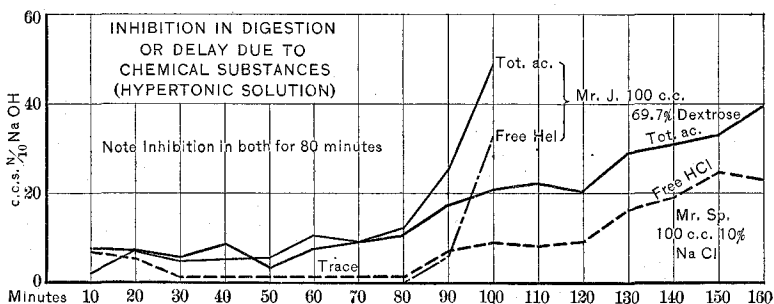


FIG. 4

secretion during the second phase. This has been endured for years, and yet there was absolutely no evidence of any irritation on the part of the stomach, no bacteria, mucus, or blood—simply a dry achylia, from which juice was filtered, with difficulty in the first phase and distinctly more abundant in the second phase. Furthermore, evidence of both pepsin and rennin were found throughout later phases.

CASE IV.—Mr. K. was referred by Dr. Beardsley and Dr. Tracey, Beverly, New Jersey. This case was one of unusual interest, inasmuch as it presents the many phases and causes which might be

operative in causing an organic achylia and in which a bad prognosis was fortunately incorrect. Mr. K., aged forty-seven years, hard worker, and exposed to considerable nervous tension, has been suffering for many years from an obscure gastric condition. Ten years ago, when seen by Dr. Musser, he was found to have an achylia with gastric catarrh and dilatation. At the time when I first saw him his condition was deplorable, his appearance a grayish green, and markedly anemic. He complained of bringing up a small amount of yellowish mucus every morning. His condition to the attending physicians suggested a pernicious anemia, and I must confess that it seemed that such a course was likely, although a complete blood picture and certain signs were atypical. Wassermann was negative, and before I made a gastric study, another physician had made an examination, found a great deal of pus and mucus in the stomach, and a complete achylia according to the ordinary methods. The empty stomach revealed little retention, but a great deal of mucus, and the fractional examination after the administration of the Ewald meal showed the following:

Time.	Total acidity.	Free acid.	Mett pepsin.	Rennin.
5 mins.	1.0	0	0	0
15 "	1.0	0	0	
30 "	1.5	0	0	
45 "	1.5	0	0	0
1 hour	4.0	0	0	
1½ hours	4.0	0	0	
1½ "	5.0	0	0	0

Total achylia in every phase, an enormous amount of mucus, pus which had been clearly swallowed, many bacteria, some swallowed and others intimately mixed with the contents; *no enzymes*; absolutely no response, and tinged throughout in each case with blood. Neoplasm ruled out, owing to the duration, the relatively low loss in weight, absence of mass, and of any Roentgen-ray findings and the diagnosis of achlorhydria hemorrhagica gastrica secondary to ingestion of infected mucus from probable bronchiectosis in lung. To make a long story short, diet was immediately regulated, lavage and the direct local application of silver was carried out, iron and arsenic given hypodermically, and parathyroid given, gr. $\frac{1}{10}$, t.i.d., for three days at intervals. After three months he had gained twelve pounds in weight, his blood had gone up to 4,200,000, his hemoglobin over 80 per cent., his appetite had completely returned, but the important thing was the gastric analysis, after an achylia of ten years' duration, in which we all felt justified in believing there was an atrophic gastritis:

Time.	Total acidity.	Free acid.	
15 mins.	6.0	0	
30 "	0	
45 "	15.0	0	
1 hour	35.5	Trace	Pepsin present.
1½ hours	55.0	Strong trace	Free acidity.
		Rennin—not tested.	

Still some mucus, but infinitely less than on former occasions, and a few bacteria which have been gradually stamped out. I am not prepared to believe that the parathyroid is entirely responsible for this change. In fact, the hypodermic administration of hematinics may have wrought a change; furthermore, I acted on the principle that nutrition was the important thing in his case, increased assimilation being followed by marked improvement. Among the interesting points in this case was the return in the salivary secretion to which the patient himself called attention; furthermore, the tongue, which was glossy and rather pale at first, became bright red, with papilla distinct. The bowels, which were markedly constipated, phenomena of mucus colitis being frequent, were once more regulated, although it must be confessed a small amount of magnesia was and is being used. It is my belief that parathyroid is in part responsible for the return of the secretion, inasmuch as qualitative tests on other occasions did not reveal such a pronounced effect. The gain in weight was from 131 to 158 pounds, and at this writing, nine months later, the cure is complete.

CASE V.—Represents Mrs. Si., aged thirty-eight years, who has been suffering for three years with nausea and vomiting and an obscure gastric affection which suggested neoplasm. Her curve shows an absolute achylia in every phase and no enzymes. Abderhalden reaction was negative, and Roentgen-ray studies show, outside of marked ptosis of both stomach and large bowel, no evidence of any neoplastic condition. Stool examinations show connective tissue which has come through, but otherwise poor utilization of fats. The case exhibits also hyperthyroidism, and is at present under observation. There is undoubtedly a marked catarrhal process present, and two examinations at an interval of two weeks reveal complete achylia:

Time.	Total acidity.	Free acid.	Pepsin.	Albumen.	Rennin.
5 mins.	2.0	0.0	0	..	0
10 "	2.5	0.0	0	80	0
15 "	3.0	0.0	0	..	—
30 "	4.0	0.0	0	..	—
45 "	4.45	0.0	0	..	—
1 hour	6.0	0.0	0	80	0
1½ hours	5.0	0.0	0	..	—
1½ "	10.0	Trace	0	80	? 30 min.
1½ "	9.0	?	0		

Gastric mucus in every specimen.

Digestion of an Ewald meal is over in one and three quarter hours. It will be seen that there is practically no elaboration of acid; there is, however, a trace to be found in the more advanced stage of digestion. There is a large amount of mucus, illustrative of a pronounced catarrh. The question which arises is naturally that between a neoplasm, a benign achylia, and a pronounced infected gastritis (achlorhydia hemorrhagica gastrica). Against the former is the

blood count, the condition of the patient, the peculiar type of the albumin curve, which in that condition steadily increases. Furthermore, there is to be found no lactic acid, no Oppler-Boas bacilli, but some small diplobacilli and bacteria.

CASE VI.—Contrast the preceding with the following case of spurious or false achylia in a case of marked gastric catarrh.

Mrs. H., suffered from typical loose bowels—with apparently no definite cause, indigestion, discomfort, eructations after eating. Occasionally cramp-like pain in the upper abdomen. Empty stomach negative, except for small residuum almost entirely composed of gastric mucus.

An Ewald meal gave on fractional examination the following results:

Time.	Total acidity.	Free acid.		
5 mins.	2.0	0	Mucous	
10 "	2.0	0	Mucous	
15 "	3.5	0	—	
30 "	4.0	0	—	
45 "	4.0	0	—	—pepsin +
1 hour	5.0	0	—	—pepsin +
1½ hours	3.5	0		
1½ "	15.5	0	—	—pepsin +
1½ "	23.6	0		Rennin—not tested.

Here was a case of chronic gastritis with hypermotility and the typical gastrogenous diarrhea incident to a lack of gastric secretion. Undoubtedly the case would be placed in the achylia group, and yet pepsin, when properly activated, was found when tested. There is here once more a complete inhibition or delay of the psychical secretion to be followed by an appreciable secretion during the second stage of gastric digestion. The specimens in this case answered the description of wet achylia. After thorough irrigation and treatment of the stomach, perceptible free acid was found earlier in the digestive cycle.

(NOTE.—At present writing, some six months later, well; but incomplete return of secretion.)

CASE VII.—Mrs. Gr. is a case in every way similar to the case described as Case VI. Empty stomach is negative, but in this young woman, who complains of discomfort and distress after eating, no actual pain shows the following findings after the administration of an Ewald meal:

Time.	Total acidity.	Free acid.	Pepsin.
5 mins.	4.0	0	0
10 "	4.0	0	0
15 "	5.0	0	0
30 "	7.0	Trace mucus	+
45 "	11.0	Trace mucus	+
1 hour	29.0	6.0 mucus	+
1½ hours	30.0	Trace mucus	++
1½ "	6.0	mucus	
1½ "			

Prolongation of digestion; still an appreciable rest after two hours; intimate mucus in all the specimens, indicating a well-marked catarrh; occult blood negative; starch digestion advanced; yeast, trace; lactic acid, slight trace; many bacteria indicating an infected mucosa; likewise vegetable debris, but no meat, there being atony and stagnation.

Spurious achylia, catarrh, atony, dilatation (?)

We have been able to demonstrate an experimentally induced achylia even in hypersecretory individuals by means of certain hypertonic solutions. The results of this work will appear shortly but it seems proper to state that both hypertonic salt solution and dextrose solutions are capable of inducing a definite delay in the appearance of gastric secretion for eighty minutes or more. This is of considerable interest inasmuch as water alone is capable in these subjects of giving rise to a perceptible secretion.

In conclusion we may state:

1. True achylia in which there is a total lack of acid and enzymes through the entire period of gastric digestion is exceedingly rare.

2. By means of the fractional method we have been able to study the entire period of gastric digestion in cases of achylia. On the basis of Pawlow's work, it is suggested that if his conception of gastric secretion be correct, it should follow that achylia can be either psychical or chemical. A total absence of secretion in the first hour of digestion, followed by a perceptible secretion in the second, would favor the belief that a psychical achylia (nervous) exists. The reverse, falling off in secretion, would favor the interpretation of a chemical achylia. A total lack of secretion through both phases might indicate a deficiency of both functions or an inactive mucosa.

3. Our studies show that the commonest form is a complete lack of gastric secretion through both phases (total achylia); two cases were encountered of true psychical achylia, but a pure chemical achylia was never encountered.

4. Attention is called to spurious achylia, which is quite common, and in which there is an ultimate elaboration of juice late in digestion, and always enzymes present.

5. By means of the administration of parathyroid extract in two cases of *bona fide* achylia, one of over ten years' duration, a perceptible return of the gastric secretion was noted during the psychical phase. Dietetic and local treatment were instituted at the same time.

6. The phase method of examination is of great value in determining the type of achylia as well as the possibility that at some phase the secretion might still be active, as shown in several of the cases recorded. This finding distinctly improves the prognosis.